Grammatical Subjects in Method Section of Psychology and Chemistry Research Articles

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Abstract

This study intends to investigate the realizations and functions of grammatical subject in the method section of research articles across disciplines from hard and soft sciences. To this end, 20 method sections of research articles from two disciplines, namely Psychology and Chemistry, were selected and analyzed. The data were selected from high impact journals indexed in Thompson and Reuters and published by Elsevier. The data were analyzed based on Ebrahimi's recent analytical framework for the analysis of grammatical subject. The results highlighted noticeable disciplinary differences concerning realizations of the research-related and self-mention grammatical subjects. The results of this study could act as a guide to aid novice writers, especially non-native novice writers from these two disciplines with regard to the use of grammatical subject which serves as an important point in the navigation of subsequent ideas in a message. The findings also stressed that writers need to consider the writing style of their disciplines in realizing linguistic features, such as grammatical subject functionally.

Keywords: method section, research article, grammatical subject, genre

Introduction

As a rhetorical section of a research article, the method gives salient and sufficient details to describe how a study is conducted. A primary function of the section is to establish data validity and contributes to the need of researchers in the systematic verification of methodological procedures when deemed necessary. The method section comprises pertinent information with regard to: a) participant, b) instrument, and c) procedure (Jalilifar, 2009). Participants' information elaborates on the characteristics, selection and number of participants, often taking note f demographic in relation to gender, age, level of education and instructional affiliation, economic status and geographic location. Regarding instruments, standard procedural information, which could include the use of tests, interviews, survey questionnaires, inventories or observations, is given. Following the description on the method of data collection and the details of its

execution, another feature is the methods used for analyzing the data.

Compared with other sections of a research article, it has been claimed by many researchers that this section has received relatively less attention (Bruce, 1983, 2008; Swales, 1990; Lim, 2006; Gollin-kies, 2014). One definite aspect that could be further worked is the grammatical subject (GS) in the discourse of method section. A review of work on GS uncovers works concerning the realizations of GS in different genres (Gosden, 1993; Lores, 2004; Borsinger, 2003; and Ebrahimi and Chan, 2015).

Lores (2004) analyzed 36 research article abstracts from four highly reputed journals in the field of linguistics –the Journal of Pragmatics, Linguistics, Journal of Linguistics, and Applied Linguistics. Nine abstracts were extracted from each journal. She initially scrutinized the corpus for the rhetorical structure and to trace the use of GS, she drew on Davies' (1988) sub-categorization of the grammatical subject. Davies' (1988) sub-categorizations include the dominance of the following domains: participant, discourse, hypothesized and objectified, and real-world. The result also showed that the GS used in the introduction fell mostly within the discourse domain. Within the method, result, and discussion moves, the real-world domain was more dominant. This dominance supported a "transition from more text-related perspective to more objective, external-world related views" in the text (Lores, 2004, p. 295). She finally concluded that the structuring of the GSs in research article abstracts is not a random occurrence.

In addition, Borsinger (2003) studied the GS in novice and expert research writing. She compared the published drafts of research papers written by doctoral students in Physics and expert Physicists respectively. The GS was analyzed based on the four domains: participant, discourse, conventional, and instantial. Her analysis included only the main clauses in the primary organization of a text which is deemed to give a clearer representation of significant GSs found in the text. Secondary GSs were ignored as they were viewed as distracting and interfering with the core message. She found that both categories of writers used conventional class frequently (encompassing three quarters of the GSs analyzed), which suggested a deliberate avoidance of the interpersonal feature in text development. With regards to the other classes, the writers showed different tendencies towards the participants and discourse domains. The participant received greater attention from the expert writer–twice as often compared to the novice writers. The focus in use was the first person plural pronoun '*we*'. The expert writer did not use the discourse domain much, thus showing a reluctance to refer directly to results and figures, and the research outcomes. Rather, the analysis pointed to the use of the instantial GS which occurred three times as often compared to the novice writer.

On the other hand, the discourse function of the GS in a corpus of 36 research articles was investigated by Gosden (1993). These research articles were selected from the three disciplines of Physics, Chemistry, and Biological sciences. The research articles were extracted from 12 international academic journals, which were written by

native writers and published at universities in the U.K., U.S., and Canada. These journals are widely read in these three disciplines and are popular publication targets for disciplinary research writings. To analyze the data, he used Davies' (1988) of the GS in terms of discourse functions which are a) the participant domain, b) the discourse domain, c) the hypothesized and objectified domain, and d) the real-world domain.

Initial results indicated that the writers had used the GS in starting two thirds of the total sentences found. This would mean that the writers in all three disciplines had selected the GS as a major point of departure with the dominance of the real-world domain. Gosden (1993) explained that this predominance emphasizes the empirical content of the scientific research articles. The greater use of the real-world domain resulted from the significant presence of self-evidence in the writings. He also concluded that the rhetorical development of the GS is manifested differently as revealed by the patterns of the thematic structures.

More recently, Ebrahimi and Chan (2015) analyzed the discourse functions of the GS in research article abstracts from two disciplines, namely, Applied Linguistics and Economics. The corpus consisted of 60 research article abstracts (30 from each discipline) extracted from 2010 and 2011 issues of the journals of Applied Linguistics and Oxford Economic Papers. The analysis of the corpus was based on the classification of discourse functions of GSs suggested by Gosden (1993) which also included the four mentioned domains. Findings revealed disciplinary differences in relation to the discourse functions of the GS enactments in both groups of RA abstracts. Disciplinary differences appeared to be determined by a conscious how the writers mapped and balanced the use of these four domains in their RA abstracts. In other words, the findings fundamentally stressed the claim that "academic writing is shaped by the writer's disciplinary background", with reference to particularized use of the GS in text development.

The literature review showed that little attention was accorded to the study of the GS in the method section of research articles. In addition, due to the importance of GS slot in the comprehension and understandings of information stated in rest of the sentence, the present study aims to functionally analyze the realizations of GS in the method section of research articles (RAM) from two divergent disciplines, namely Psychology and Chemistry.

Method

Design

This study employed a mixed method design that includes both qualitative and quantitative tools. The quantitative analysis presented the frequency of realizations of GS types used in the RAM sections from the two disciplines (Psychology and Chemistry). The qualitative analysis presented the discourse functions of the GS types used and projected viable explanations for their use.

Sampling procedure

To collect the data for analysis, the researcher went through the following procedures. First, the researcher selected two

disciplines which could represent the writings of social science and hard science based on Becher's (1994) taxonomy, which offered a reasonable criterion for the selection of disciplines.

Following the selection of the disciplines, the next step was to ensure content validity and exemplary writing. The Thompson and Reuters index was used as the benchmark and verified by reference to an established publisher, Elsevier. For this purpose three journals from each discipline were selected (see Appendix 1).

The third step was to select RAs from which the RAM sections could be extracted. To this end, 20 RAs (10 from each discipline) were selected based on the following criteria: A) The RAs should have the macro structure of Introduction, Method, Result, and Discussion (IMRD) as proposed by Swales (1990). This criterion was set due to the fact that it has been successfully employed by researchers investigating texts in many disciplines, such as Applied Sciences, Psychology, and Hard Sciences' disciplines (Jalilifar, 2006, p. 147). Adhering to the same macro structure across the corpus enabled the researcher to develop a better frame of reference for the analysis of the micro structure level features, among which was the GS. B) The RAs selected had to be data-based. There were three reasons for limiting the focus to data-based RAs. The first was related to the consideration of Swales' (2004) caution that RA may not be a single genre, but rather it could comprise three genres – experimental (data based) RA, theoretical RA, and the review RA. Second, there are many data-based research articles that lend themselves well to the analysis of the IMRD structure and, third, there is a high inclination towards the publication of data-based RA (Jalilifar, 2009). To give currency to the publications, the selected RA was published between 2008 and 2012 (two RA sets from each year). This helped to moderate changes that may occur in style preference, as some journals do modify their requirements as an update.

Framework of analysis

This study employed the framework put forth by Ebrahimi (2014). This was motivated by two points: First, it has been tested for use as a conceptual framework for the analysis of sentence initial elements in academic writing genres such as the RA; second, it is a recent comprehensive framework that has been developed after a survey of earlier available frameworks. The framework is illustrated as follows:

Procedure

To analyze the GS types and discourse functions, the analytical procedures were as follows: First, 10 data-based RA from each discipline were extracted from the target journals following which RAM sections were extracted and converted into a word file. Second, after establishing the data, The 20 RAMs were carefully scrutinized and analyzed, the main clauses were identified. After having identified the main clauses, the GS of each main clause was isolated and counted. Third, the detected GS were subject to analysis by using Ebrahimi's (2014) framework to narrow down the GS types and discourse functions. During this step, the data

Table 1
GS types and functions

GS types	Function and Example
Research-related Object	**Function**: To present materials, entities and objects concerned with the physical world.
	Example: ***The three disciplines*** were selected as examples of the sciences (biology), social sciences (linguistics) and humanities (philosophy).
Research-related Process	**Function**: To present actions and procedures executed in or resulting from scientific research activities.
	Example: ***A movement away from the target*** is seen as avoidance behavior, with negative valence.
Introducing (part) the study	**Function**: To refers to integral, parts or internal entities of a discourse.
	Example: ***The purpose of this paper*** is to present a generic description of discursive practices in law as they emerge from two different international academic and professional contexts of written communication. (AL 7)
Personal Citation	**Function**: To refers to earlier researchers by citing the authors' names of earlier studes.
	Example: ***Ryalls et al. (1997)*** reported that females produced longer positive VOTs for voiceless plosives and smaller negative VOTs for voiced plosives.
Impersonal Citation	**Function**: To refers to earlier researchers by citing the community-validated studies.
	Example: ***Studies*** suggest that perfectionism may be important in social anxiety disorder.
Self-mention	**Function**: To clearly present the author(s) and mostly recognized through the use of 'we', even in the case where there is a single named author.
	Example: ***We*** perceive speech sounds categorically—that is to say, we are more likely to notice the differences between categories than within categories.
This	**Function**: The GS is clearly recognized through the use of "this".
	Example: ***This*** results in the INTRODUCTION and BODY sections of Opinions to be less than concise and focused statement of the relevant law, and therefore leads Italian writers to give their Opinions a feel of a legal Essay.
Empty Theme	**Function**: To postpone research-related entities and events characterized by seemingly formulaic patterns
	Example: However, ***it*** appears that the IAP might be an even more promising instrument than the IAT.

was 'cleaned' several times by means of repeated reviews to mitigate any ambiguous detection of the discourse functions. This was especially vital in the analysis of discourse functions of GS in the Psychology and Chemistry RAMs, as the topics covered in these RAMs were specifically not in the language studies discipline of which the current researchers are aligned to. As a result, in doubtful cases, the researchers sought confirmation with an M.A. or PhD candidate who was conducting research in the Pyschology and Chemistry disciplines. Fourth, having analyzed all of the GS for the types and discourse functions, the researcher increased the reliability of his analysis by seeking confirmation on the initial analysis of 80 RAMs from three PhD candidates in Applied Linguistics who had experience in researching and publishing on topics quite similar to the present article. Finally, the frequency and occurrence of the GS types and discourse functions were recorded and tabulated for the RAMs to be discussed across the disciplines.

Results and Discussion

Research-related Object

The results of data analysis concerning the frequencies and functions of GS types and functions are presented in Table 2 and 3. The results are discussed in the following subsections.

The results of the data analysis indicated the predominance of the research-related object GS over other GSs (see Table 2 and 3). The employment of this GS fluctuated between 73% in Chemistry to 84% in Psychology RAMs. This finding might well suggest that Psychology writers have a greater tendency to elaborate on the materials, data, and objects dealt with in the articles compared to their counterparts in Chemistry. A plausible reason for this elaboration might be related to the need for more explanation in Psychology studies as they are related to human phenomena. As such, the comprehensive descriptions of such resources is likely to entail more details to ensure that the reader is clear about the data and will be convinced about the method feature. These descriptions would have a bearing on objective reporting and the significance of the results that emerges from the descriptions of the object under study.

Table 2:
Frequency and Percentage of the GS in RAM

		Psychology	Chemistry
1	*Research-related Object*	566 (84%)	359 (73%)
2	*Research-related Process*	75 (11%)	110 (22%)
3	*Self mention*	15 (2%)	4 (1%)
4	**Others*	20 (3%)	19 (4%)
	Total	676(100%)	492(100%)

*Others include GSs that did not reach 5% occurrence in at least one discipline.

As for the discourse function, this GS was used specifically to identify, explain, and define the participants or materials on which the study was based (see Table 3). This discourse function was evident in the two sets of RAMs (Example 1-2). This discourse function might support the results of the move and step analysis of RAM put forth by Lim (2006). He indicated that, with regard to moves 1(describing data collection procedures) and 2 (describing procedures for measuring variables) of the RAM, writers need to describe, define, and explain the characteristics of the sample, data, participants and variables. Therefore, to describe these steps explicitly, writers need to thematise the sample, data, participant, and variables in the form of clearly stated GS and thereupon elaborated on accordingly.

Table 3

Discourse Functions of the GS in RAM

	GS	Discourse Function	Psychology	Chemistry
1	Research-related Object	Identify, explain, and define participants or materials of the study	✓	✓
2	Research-related Process	Identify, explain, and define the processes adopted in data collection, analysis and measurements	✓	✓
3	Self mention	Describe the process or the procedure	✓	✓
		Highlight contribution to the existing literature	✓	*

Example 1: ***The controls*** were recruited at the university campus through advertisements and included if they ever experienced an overwhelmingly frightful experience that had occurred at least one month ago, of which its which trauma-nature was Checked by two questions referring to the DSM-IV A1 and A2 trauma criteria. (Psychology 3)

Example 2: Hence, in this study, ***Tedlar bags*** are used as a storage media of VOC for both pure gaseous standards and real samples. (Chemistry 3)

The two examples above illustrate the extent of description employed thus substantiating that the research-related object as the focused GS had deserved greater attention in the psychology discipline. Thus it appears that there is a greater obligation to identify, explain and define the sample, participants, materials and variables on which the study is based in this discipline.

Research-related Process

A clear disciplinary difference also emerged from the data analysis concerning the employment of the research-related process GS (see Table 2). The Chemistry writers were found to use this type of GS more which could stem from the experiment-based nature of chemistry as a hard science discipline.

As for the discourse function, this GS was used to identify, explain, and define the processes adopted when conducting data collection, analysis and measurements (see Table 3). Following Lim (2006), in this

rhetorical section, writers need to state the processes used to carry out the study and, more specifically, the three moves of data collection, measurement, and analysis. Detailing these processes could help readers who wish to carry out similar experiments using the same processes. It could be inferred that chemistry writers give greater focus on process related subject to convey the message in the RAM leading to the possibility that such a GS is a more effective manner of conveying the message in chemistry RAM compared to that in psychology. It could also be inferred that there is greater weight laid on replication of research in hard science. With regard to these studies, writers needed to provide a detailed explanation of the processes followed when conducting an experiment With regard to these studies, in the RAM section, writers needed to provide a detailed explanation of the processes followed when conducting an experiment. This was not the case in the soft science RAMs, where writers preferred to discuss the materials in greater detail than the processes adopted. This, in turn, required writers to make more reference to the objects or materials in the thematic position. Example 3 and 4 illustrate the realizations of the discourse functions in two sets of RAMs.

Example 3: ***Ratings*** were summed for various domains and for all items to yield a total score, with higher scores being indicative of higher levels of disgust sensitivity. (Psychology 2)

Example 4: ***The titration processes*** were repeated until there was no change in the spectra for at least four times titrations indicating binding saturation had been achieved. (Chemistry 2)

Self Mention

As shown by the figures in Table 2, both groups of writers were not inclined towards the use of the self mention GS. This finding indicated that the nature of the Chemistry and Psychology RAMs are less interactional. It also showed that Chemistry and Psychology writers do not prefer to express their viewpoints and stances via self mention GS concerning the research process to their community members.

In relation to the discourse functions served by the use of the self mention, the results illustrated certain disciplinary differences (see Table 3). The main discourse function served by this GS was describing the process or procedure (Example 5-6). The use of the self mention to serve this discourse function could be justified on the grounds that writers need to explicitly describe the processes or the procedures in the RAM. For Lim (2006 p. 294), the use of self mention in this manner could "further the objective of vigorous, direct, clear and concise communication" in the RAM. Additional support for this use came from Tang and John (1999), Kuo (1999) and Harwood (2005), who insisted on the use of self mention to serve this discourse function and to provide the reader with adequate information concerning the processes and procedures of research.

Example 5: ***We*** used AMOS's missing data estimation procedure to account for minor missing data, which was less than 5% in both samples, with the exception of the state anxiety measures, for which 8 participants were missing due to refusal to give the speech. (Psychology 4)

Example 6: ***We*** selected 46 sediment samples (from 12 vibro-cores and 3 box-cores; Fig. 1) from the ones analyzed by XRF and further analyzed them by means of EPXMA [16] five months after the cruise. (Chemistry 4)

Another discourse function enacted by the use of the self mention was highlighting a researcher's contribution to the existing disciplinary-based knowledge. This discourse function was more markedly found in the Psychology RAMs (Example 7). For Harwood (2005), this discourse function helps writers in terms of "advertising their works as researchers" (p. 1213). This contribution was also found to be helpful in signalling the innovativeness of the procedures and processes undertaken. In this regard, Kuo (1999) pointed out that the writers seek confirmation of their contribution to discipline-based knowledge. This contribution could also be in terms of overcoming a methodological difficulty (Harwood, 2005).

Example 7: To individualize the IAP, ***we*** developed a girl and a boy version of the task and the first letter of the child's first name was used as one of the Me stimuli. (Psychology 1)

Conclusion

This focused study investigated the realizations and functions of GS in the writing of the method sections in research articles from two disciplines, namely Psychology and Chemistry which illustrate the social and hard science division respectively.

The data were analyzed, and results showed that the use of the research article object was prioritized, followed very much less by the research article process GS and finally quite negligibly by the self-mention GS. In fact, the research article object GS had three quarters of the total GS occurrence. This figure showed a very strong preference among writers in GS manifestation. Given this preference, it is to be expected that much of the writings are developed in connection with this GS. This means that much attention is given to the elaboration of the object or material. Thus much thematic development evolves from this GS and writers could be made aware of the nature of writing development governed by the GS. The rhetorical matters would stay in synch with the GS focus and in this way, writers learn about clarity of writing that plays its part in total coherence. The results also point to a greater inclination of psychology writing in pursuing the use of research-related GS compared to chemistry writing. On the other hand, the process-related GS is preferred by Chemistry writers.

Overall, the RAM section in a research article heavily characterized by the object-related GS and as mentioned, the results indicate the significant influence of rhetorical functions of the method section itself in how the writers would elaborate their GSs.

The results of this study could have implications for novice writers when developing the research article method section. Indeed, these novice writers, who possibly lack knowledge of genre writing, are likely to find information on GS choice and development useful in general. Specifically, an awareness of discourse functions of the GS could add to meaningful practice in sentence

formation and subsequent effective paragraph development in the method section.

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Appendix A

Journal from which the corpus was extracted.

Psychology

1. *Behaviour Research and Therapy*
2. *Journal of Experimental Child Psychology*
3. *Journal of Behavior Therapy and Experimental Psychiatry*

Chemistry

1. *Microchemical Journal*
2. *European Polymer Journal*
3. *Journal of Molecular Structure*